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therefore, been a scientific congress of great importance.

The papers which have been read before the Association proper and in joint session with the more closely affiliated societies have been numerous and of a high order. About three hundred and sixty papers have been thus presented, which is a great increase over the number read at the last meeting of the Association.

A number of important measures concerning the future of the Association have been considered and amendments to the constitution have been adopted rendering the council more permanent in its membership and thus probably more efficient in its work, and also making the sectional committees so constituted as to render their greater efficiency a matter of practical certainty.

About sixty new members have been elected during the meeting, and about eighty members have been made fellows.

Pittsburgh and its vicinity have provided visiting points of great scientific interest, and the fact just stated, together with the great courtesy and hospitality of the local committee and the citizens of Pittsburgh, have combined to make the meeting now coming to a close a memorable one in the annals of the Association.

SCIENTIFIC BOOKS.

Reports of the Princeton University Expeditions to Patagonia, 1896-1899. IV., *Paleontology*; Part II., Tertiary Invertebrates. By A. E. ORTMANN, Ph.D. Princeton, the University. 1902. 4to. Pp. 45-332; pl. XI.-XXXIX.

The reports of the important expeditions sent to Patagonia by Princeton University are being published at the expense of the J. Pierpont Morgan fund, and in the present stately volume we have the details of the stratigraphic paleontology for which those interested in the

geology of South America have been eagerly waiting.

The volume is printed with elegance and taste and the plates, while a little formal in drawing, are a refreshing contrast to the wretched phototypes which disfigure so many recent European paleontological memoirs. While the photographic process is suited to the reproduction, from the specimens, of a limited class of objects, in a limited number of cases, it completely fails to give what is required in the case of fossil mollusks. When small, all important details are apt to be lost; and, when large, the presence, in spots, of bits of detail, only emphasizes the general failure of the process as a whole. For this reason we congratulate the author and editor of this volume that they resisted the possible temptation and have given us illustrations which really illustrate. But one criticism occurs to us in reviewing the make-up of the volume, and that is a regret that an index to the paper is not included in it.

The memoir begins with an enumeration and description of the material collected. A painstaking comparison is made with analogous species in the northern hemisphere and also with the species of the Tertiary of New Zealand and Australia. From the Magellanian beds 19 species are described, from the Patagonian 151, and from deposits at and analogous to those of Cape Fairweather, 15 species are made known.

It has been known for some years that the opinions of several South American workers as to the age and stratigraphy of the Patagonian and other horizons, which they knew only from fossils collected by others, were much in need of revision. Two years ago Mr. J. B. Hatcher, in charge of the expedition, after careful inspection of the type localities, and Dr. Ortman on the testimony of the fossils collected, arrived at certain conclusions which were published with sections in the *American Journal of Science* for 1900. The paleontological evidence upon which those conclusions rest is now furnished in the fullest detail. If any one hitherto has suspended judgment, he may now yield to conviction in full confidence that the case is proved. No question can arise,

after the present demonstration, as to the analogy which exists between the Chesapeake Miocene of North America and the Patagonian beds of Ortmann and Hatcher. The number of species which are known from the Magellanian beds is small, and they are not especially characteristic, but, taking the singular unanimity with which Oligocene strata in the New World and on the Pacific coast of Asia are associated with lignitic deposits, and the fact that such deposits overlie the Magellanian beds, it can hardly be doubted that we have here a series either Oligocene or upper Eocene. On the other hand as little doubt remains that the Cape Fairweather beds represent in the south the Pliocene of the northern hemisphere.

After discussing these questions historically and otherwise in the fullest manner, Dr. Ortmann concludes his memoir with a discussion of the theory of Antarctica, or the existence in geological time of land connections between the different austral countries. This portion of the paper is illustrated by an excellent bathymetric chart of the earth south of the thirtieth parallel of south latitude. The author accepts, in the main, the theory broached by Rüttimeyer in 1867, as modified by Charles Hedley of Sidney, Australia, in 1895, that during the Mesozoic or older Tertiary time, a strip of land enjoying a mild climate extended across the south polar regions from Tasmania to Tierra del Fuego, approaching Tertiary New Zealand near enough, without joining it, to receive by flight or drift many plants and animals.

An excellent bibliography closes the text of this very creditable volume, on the publication of which we may congratulate the author and editor.

Das Eisen als das thätige Prinzip der Enzyme und der lebendigen Substanz. By N. SACHAROFF. Translated into German by M. RECHTSAMER. Jena, G. Fischer. Pp. 83. Two plates.

This monograph represents the attempt of the author to afford a comprehensive and universal explanation of the manifold phenomena which are ordinarily termed 'vital' re-

actions. An exposition of the importance of the deductive method in attacking the fundamental problems of biology forms the introduction to the discussion. In distinction from the cellular theory, a chemical theory of life is proposed. The cell is merely the mechanism which protects the living substance against the destructive forces of its environment, and secures the possibility of growth and reproduction; it is not an absolutely indispensable condition for the continuance of vital processes. The fundamental hypothesis of the author assumes, as the cause of such processes a cleavage of the living substance brought about by the oxidation of minimal quantities of iron contained within it in the form of a nuclein—bionuclein. This cleavage is accompanied by hydrolysis. Complete anaerobiosis thus cannot exist.

The experimental evidence for the probability of this hypothesis is derived from a study of the behavior of gelatin towards the vegetable enzyme papayotin (papain). The action of enzymes depends upon the oxidation and reduction of the small quantities of iron-containing binuclein of which they are in part composed. Many of the facts ascertained by Spitzer in his extensive investigations on the oxidizing properties of the tissues are recalled. From data of this kind the explanation of a series of general biological phenomena is derived. For example, the formation of new molecules of living substance is attributed to a reconstruction and restitution of the remains of old molecules. The nucleus of the cell represents an available supply of the indispensable binuclein. The cell proper is an aggregate of similar molecules of living substance which occur in uninterrupted rows and are surrounded by a reducing substance. A detailed discussion of the various forms in which the hypothesis is applied to the most diverse phenomena, such as karyokinesis, muscular contraction, nervous irritability and conductivity, the action of the special senses and the central nervous system, cannot be entered into here. The monograph is a striking illustration of the translation of a very limited number of experimental observations into terms of universal application. We believe that the

reader will find as much of the obscure and undemonstrated in this attempt as has characterized other similar trials in recent years.

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Linear Groups with an Exposition of the Galois Field Theory. By L. E. DICKSON, Assistant Professor of Mathematics in the University of Chicago. Leipzig, Teubner's Sammlung von Lehrbüchern auf dem Gebiete der mathematischen Wissenschaften. 1901. Vol. VI. Pp. x+312.

In 1898 the well-known firm of B. G. Teubner, Leipzig, Germany, began the publication of the 'Encyklopädie der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen,' which is intended to give in seven large volumes a general outline of the known parts of mathematics, together with applications. As a comparatively small amount of space could be devoted to each subject, the same firm decided to publish a large series of advanced text-books in connection with this encyclopedia. This series was planned especially to enable the authors of articles for the encyclopedia to develop their subjects more fully, and thus make their articles more useful. Other writers are, however, invited to make the series as complete as possible.

More than fifty different volumes of this series have already been announced by almost as many different authors. The list of authors includes a number of prominent writers of various countries. The great majority of these are Germans, as might have been inferred from the fact that the work is due to German influence and is published by a German firm. Outside of Germany the Italians seem to have been the most active collaborators, but most of the other European countries, together with America, have promised contributions.

This series of text-books, together with the encyclopedia, will doubtless act as a very strong stimulus for greater mathematical activity, and it will tend to increase in a marked degree the German influence in higher mathematics. Never before has there been such ex-

tensive collaboration to make the recent progress in the various fields of mathematical research accessible to the student. It is hoped that this series will do much towards enabling many additional teachers of mathematics, who have sufficient leisure, to join the ranks of the investigators and to assist in developing the rich mines which have been opened in many quarters during the past few decades.

The present work is the sixth volume of the series and is devoted to a subject which has been developed principally on French and American soil. The fundamental ideas are due to the marvelous genius of Galois, who developed them in a memoir entitled 'Sur la théorie des nombres,' published in the *Bulletin des Sciences* de M. Férussac in 1830, when their author was only eighteen years old. This memoir contains the elements of a new kind of imaginaries which have since been known as the Galois imaginaries. They occupy practically the same position in the theory of congruences as the ordinary complex numbers occupy in the theory of equations.

The Galois imaginaries are generally studied by means of congruences with respect to a double modulus, composed of a prime number p and an irreducible function of a single variable $\phi(x)$. It has been known for a long time that the p^n different residue with respect to such a modulus constitute a *domain of rationality*, *Körper*, or *field*. That is, if these residues are combined with respect to addition, subtraction, multiplication or division (with the exception of division by zero) the result, when reduced with respect to the double modulus, is one of these p^n residues.

About ten years ago Professor Moore proved that every finite field may be represented as a field of this kind and he applied to it the present name *Galois field*. This important theorem exhibits the great generality of investigations with respect to the Galois field. In fact, with ordinary operational laws of algebra the generality is complete. Imbued with the beauty and interest which are attached to such general investigations, the author of the present volume has generalized all the systems of linear groups studied by Jordan with respect to the field of integers taken modulo p . He